

**K.L.N. College of Engineering**  
**Department of Mechanical Engineering**  
**Course Outcomes**  
**Autonomous Curriculum Regulation 2020**

Course Name: 20GE1L2-Industrial Practices Workshop	
CO	COURSE OUTCOMES
<b>C108.1</b>	Prepare different carpentry joints.
<b>C108.2</b>	Prepare pipe connections with different joints for domestic applications.
<b>C108.3</b>	Make the models using sheet metal works.
<b>C108.4</b>	Carry out the basic machining operations.
<b>C108.5</b>	Prepare joints using welding equipment□s.
<b>C108.6</b>	Demonstrate on gas welding, refrigeration and air conditioning processes.
<b>C108.7</b>	Carry out basic home electrical works and appliances.
<b>C108.8</b>	Measure the electrical quantities.
<b>C108.9</b>	Elaborate on the components, gates, soldering practices.

Course Name: 20GE201-Engineering Graphics	
CO	COURSE OUTCOMES
<b>C112.1</b>	Familiarize with the fundamentals and standards of Engineering graphics.
<b>C112.2</b>	Draw the orthographic projections of points, lines and planes.
<b>C112.3</b>	Draw the projections of simple solids like prisms, pyramids, cylinder and cone.
<b>C112.4</b>	Draw the projections of sectional views of solids and develop its lateral surfaces.

<b>C112.5</b>	Draw the isometric projection of simple objects, truncated prism and pyramids.
<b>C112.6</b>	Draw the free hand sketching of simple objects.

Course Name: 20GE202-Engineering Mechanics	
<b>CO</b>	<b>COURSE OUTCOMES</b>
<b>C113.1</b>	Illustrate the vectorial and scalar representation of forces and moments.
<b>C113.2</b>	Solve problems in engineering systems using the concept of static equilibrium
<b>C113.3</b>	Draw free body diagram and apply equilibrium principles for two dimensional rigid bodies.
<b>C113.4</b>	Determine the centroid and moment of inertia of plane lamina.
<b>C113.5</b>	Apply fundamental principles to solve problems in dynamics of particles.
<b>C113.6</b>	Summarize the basic principles of friction and general plane motion

Course Name: 20ME301- Strength of Materials	
<b>CO</b>	<b>COURSE OUTCOMES</b>
<b>C202.1</b>	Explain the fundamental concepts of stress and strain
<b>C202.2</b>	Determine the deformation of bars while applying loads
<b>C202.3</b>	Compute stresses due to internal pressure in cylinders and spherical shells
<b>C202.4</b>	Apply basic equation of simple torsion in designing of shafts and helical springs
<b>C202.5</b>	Construct Shear force diagram, Bending moment diagram for different beam configurations with combination of transverse loading
<b>C202.6</b>	Calculate the deflection in beams by various methods and crippling load of columns under various conditions.

Course Name: 20ME302- Fluid Mechanics and Machinery	
CO	COURSE OUTCOMES
C203.1	Determine the effect of fluid properties on a flow system
C203.2	Apply the kinematic concepts and dynamic concepts which relates to the conservation principles of mass and energy
C203.3	Compute loses in pipes, bends and fittings using conservation laws.
C203.4	Use dimensional analysis to design physical or numerical experiments and to apply dynamic similarity
C203.5	Analyze the performance of hydraulic turbines.
C203.6	Analyze the performance of pumps

Course Name: 20ME303- Manufacturing Processes	
CO	COURSE OUTCOMES
C204.1	Identify defects and interpret causes for defects in product of metal casting processes.
C204.2	Select the suitable metal joining process for a given product or component.
C204.3	Determine the power required for bulk deformation process.
C204.4	Determine the power required for shearing, bending and deep drawing.
C204.5	Explain the steps involved in manufacturing of parts by powder metallurgy.
C204.6	Choose a suitable plastic molding process and additive manufacturing process for producing a given part

Course Name: 20ME304- Engineering Thermodynamics	
CO	COURSE OUTCOMES
C205.1	Apply first law of thermodynamics and determine energy exchange in closed systems and flow process
C205.2	Apply second law of thermodynamics to determine the performance limits of thermodynamic cycles

<b>C205.3</b>	Determine thermodynamic properties of pure substances
<b>C205.4</b>	Calculate efficiency of simple and improved Rankine cycle
<b>C205.5</b>	Derive simple thermodynamic relations of ideal gases
<b>C205.6</b>	Calculate properties of gas mixtures and moist air using thermodynamic relations and psychrometric chart.

Course Name: 20HS301- Universal Human Values	
<b>CO</b>	<b>COURSE OUTCOMES</b>
<b>C206.1</b>	Explain the significance of value inputs in a classroom and start applying them in their life and profession.
<b>C206.2</b>	Distinguish between Values and Skills to ensure happiness and prosperity.
<b>C206.3</b>	Distinguish between Thyself and the Body to ensure competency of an individual.
<b>C206.4</b>	Explain the role of a human being in ensuring harmony in society and nature.
<b>C206.5</b>	Distinguish between ethical and unethical practices, and apply suitable strategy to actualize a harmonious working environment.
<b>C206.6</b>	Develop an awareness of human values to appreciate the rights of others.

Course Name: 20ME3L1-Strength of Materials Laboratory	
<b>CO</b>	<b>COURSE OUTCOMES</b>
<b>C207.1</b>	Explain the concept of determining stresses and strains from the member forces.
<b>C207.2</b>	Apply the basic concepts and effects of axial loads, shear, and torsion on structural components.
<b>C207.3</b>	Determine the young's modulus of beams by means of deflection of beam experiments.
<b>C207.4</b>	Calculate the hardness of different materials by means of Brinell and Rockwell hardness experiments.
<b>C207.5</b>	Calculate the modulus of rigidity and stiffness of spring by means of open coil and closed coil experiments.

<b>C207.6</b>	Calculate the hardness and Physical insight into the behavior materials by means of hardening and tempering experiments.
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Course Name: 20ME3L2 - Fluid Mechanics and Machinery Laboratory	
<b>CO</b>	<b>COURSE OUTCOMES</b>
<b>C208.1</b>	Determine the coefficient of discharge for Orifice meter and Venturimeter
<b>C208.2</b>	Determine the rate of flow using Rota meter and calibrate it
<b>C208.3</b>	Predict performance characteristics of centrifugal pump and submergible pump.
<b>C208.4</b>	Predict performance characteristics of reciprocating pump and gear pump.
<b>C208.5</b>	Predict performance characteristics of turbines.
<b>C208.6</b>	Determine the friction factor for flow through pipes.

Course Name: 20ME401-Kinematics of Machines	
<b>CO</b>	<b>COURSE OUTCOMES</b>
<b>C210.1</b>	Calculate the degrees of freedom in simple kinematics chain
<b>C210.2</b>	Determine the velocity and acceleration for simple mechanisms
<b>C210.3</b>	Develop the cam profile for various type of followers
<b>C210.4</b>	Determine the speed and contact ratio of gear pair and gear trains
<b>C210.5</b>	Determine the tooth load and torque in gear trains
<b>C210.6</b>	Determine the friction of various machine elements

Course Name: 20ME402- Manufacturing Technology	
<b>CO</b>	<b>COURSE OUTCOMES</b>

<b>C211.1</b>	Calculate the cutting forces in orthogonal cutting and cutting tool life.
<b>C211.2</b>	Develop process sheet for machining operation of a given part in turning machine.
<b>C211.3</b>	Calculate the machining time for producing components in shaper, drilling and milling
<b>C211.4</b>	Identify and select suitable abrasive process for producing a given product and explain the process in detail.
<b>C211.5</b>	Explain the constructional features and working principles of NC/CNC machine tools
<b>C211.6</b>	Develop CNC program for the given part.

Course Name: 20ME403- Thermal Engineering	
<b>CO</b>	<b>COURSE OUTCOMES</b>
<b>C212.1</b>	Explain the working of IC engines
<b>C212.2</b>	Calculate efficiency of gas power cycles
<b>C212.3</b>	Determine the performance Parameters of IC Engines
<b>C212.4</b>	Calculate performance of refrigeration cycles
<b>C212.5</b>	Determine cooling load using Psychrometric chart
<b>C212.6</b>	Determine the performance of Reciprocating Air Compressors

Course Name: 20HS401- Environmental Science and Engineering	
<b>CO</b>	<b>COURSE OUTCOMES</b>
<b>C213.1</b>	Describe the environment, ecosystem and their significances.
<b>C213.2</b>	Identify the threats to biodiversity and methods to conserve biodiversity.
<b>C213.3</b>	Identify and implement technological and economical solution to environmental pollution.

<b>C213.4</b>	Develop the knowledge on various natural resources and effect on environment due to over utilization.
<b>C213.5</b>	Record the consequences of natural disasters.
<b>C213.6</b>	Outline the social issues such as welfare, sustainability etc., and to relate with population growth.

Course Name: 20ME404- Metrology and Measurement Practices	
<b>CO</b>	<b>COURSE OUTCOMES</b>
<b>C214.1</b>	Design tolerances and fits for a selected product quality.
<b>C214.2</b>	Select a suitable comparator/ angular measuring device for inspecting the products in a given industry.
<b>C214.3</b>	Choose appropriate method and instruments for inspection of various forms.
<b>C214.4</b>	Select suitable advanced measuring instruments for special requirement in the industries.
<b>C214.5</b>	Choose appropriate method for the measurement of power, flow for a given application.
<b>C214.6</b>	Conduct experiments on various dimensional/physical measuring instruments and determine the parameters like diameter, angle, straightness, force, temperature,

Course Name: 20ME4L1- Manufacturing Technology Laboratory	
<b>CO</b>	<b>COURSE OUTCOMES</b>
<b>C215.1</b>	Perform various operations in Lathe.
<b>C215.2</b>	Perform shaping, drilling and milling operations.
<b>C215.3</b>	Generate gear profile using milling, gear hobbing and gear shaping machines.
<b>C215.4</b>	Use grinding machine for surface finishing operations on simple parts.
<b>C215.5</b>	Calculate cutting forces using cutting tool dynamometer in Turning/ Milling Process.
<b>C215.6</b>	Develop CNC programming for the simple components produced in CNC lathe and CNC milling.

Course Name: 20ME4L2- Thermal Engineering Laboratory	
CO	COURSE OUTCOMES
C216.1	Conduct tests on I.C Engine – 2 stroke and 4 stroke model and Calculate Valve Timing and Port Timing Values.
C216.2	Conduct tests on Flash and Fire Point apparatus and determine the value of Flash and Fire Point of fossil fuels and Lubricants.
C216.3	Conduct Performance tests on Diesel and Petrol engine Test rigs and analyze the performance Parameters of different engines.
C216.4	Conduct tests on refrigeration test rigs and determine the COP of refrigeration test rigs.
C216.5	Conduct tests on air conditioning test rigs and determine the COP of air conditioning test rigs.
C216.6	Conduct tests on reciprocating air compressor test rigs and determine the volumetric efficiency of reciprocating air compressor test rigs.

Course Name: 20ME501 - Design of Machine Elements	
CO	COURSE OUTCOMES
C301.1	Design the given machine component for static and fluctuating loads.
C301.2	Design a shaft/ coupling for a given application.
C301.3	Design a suitable spring under various loading conditions.
C301.4	Design a suitable joint for the given application.
C301.5	Design suitable sliding contact bearing for the given application.
C301.6	Select suitable rolling contact bearings from data book.

Course Name: 20ME502 - Dynamics of Machines	
CO	COURSE OUTCOMES
C302.1	Determine the dynamic forces in the reciprocating engine and calculate the maximum fluctuation of energy of the flywheel using turning moment diagram.
C302.2	Calculate the required mass and the relative angular position for balancing of several masses rotating in same plane / different planes.



<b>C302.3</b>	Determine the natural frequency of longitudinal and transverse vibration.
<b>C302.4</b>	Calculate the critical damping, damping factor, logarithmic decrement and ratio of two consecutive amplitude for the mechanical vibrating systems.
<b>C302.5</b>	Determine the amplitude of the forced vibration and it's resonance.
<b>C302.6</b>	Calculate the range of speed of the mechanical governors, and analyze the effect of gyroscopic couple on automobiles, ships and aero plane.

Course Name: 20ME503 - CAD / CAM	
<b>CO</b>	<b>COURSE OUTCOMES</b>
<b>C303.1</b>	Describe the design process and elements of CAM.
<b>C303.2</b>	Explain the fundamentals of parametric curves, surfaces and Solids
<b>C303.3</b>	Explain the different types of Standard systems used in CAD
<b>C303.4</b>	Explain the principles of tooling and drive systems in CNC.
<b>C303.5</b>	Apply CNC programming concepts to develop part programme for Lathe & Milling Machines
<b>C303.6</b>	Explain applications of IOT in computer aided manufacturing

Course Name: 20ME504 - Heat and Mass Transfer	
<b>CO</b>	<b>COURSE OUTCOMES</b>
<b>C304.1</b>	Determine heat transfer rate in simple geometries under steady state and transient conditions by applying heat conduction equations.
<b>C304.2</b>	Determine heat transfer in internal and external flows by applying free and forced convective heat transfer correlations.
<b>C304.3</b>	Calculate heat transfer rate during boiling and condensation.
<b>C304.4</b>	Determine the performance of different types of heat exchangers by applying LMTD and NTU methods of thermal analysis.
<b>C304.5</b>	Calculate radiative heat transfer between different types of surfaces.

<b>C304.6</b>	Calculate mass transfer rate by applying diffusive and convective mass transfer equations and correlations.
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Course Name: 20MC501 - Constitution of India	
<b>CO</b>	<b>COURSE OUTCOMES</b>
<b>C306.1</b>	Explain history and philosophy of Indian Constitution.
<b>C306.2</b>	Explain the premises informing the twin themes of liberty and freedom from a civil rights perspective.
<b>C306.3</b>	Explain the powers and functions of Indian government
<b>C306.4</b>	Explain the emergency rules of Indian Constitution.
<b>C306.5</b>	Explain the structure and functions of local administration.

Course Name: 20ME505 - Machine Drawing	
<b>CO</b>	<b>COURSE OUTCOMES</b>
<b>C307.1</b>	Explain the Indian standards for the preparation of machine drawing.
<b>C307.2</b>	Draw the symbols for the standard machine parts.
<b>C307.3</b>	Calculate and Identify the type of limits and fits for the given tolerance grade.
<b>C307.4</b>	Interpret the information from the given production drawing.
<b>C307.5</b>	Explain the assembly requirements and the sequence of assembly.
<b>C307.6</b>	Draw the assembled view of the mechanical products from the given part drawing.

Course Name: 20ME5L1 - Dynamics Laboratory	
<b>CO</b>	<b>COURSE OUTCOMES</b>
<b>C308.1</b>	Calculate the deflection of the cantilever beam and Determine the critical speed of the shaft.

<b>C308.2</b>	Determine the unbalanced mass and relative angular setting for balancing the rotating body and cam analysis
<b>C308.3</b>	Calculate the natural frequency of the longitudinal, transverse and torsional vibratory systems.
<b>C308.4</b>	Calculate the Effect of Actual Spindle Speed on Sleeve Displacement, Effect of Radius of Rotation on Centrifugal Force and draw the characteristics curve for
<b>C308.5</b>	Determination of Mass moment of inertia of Fly wheel and Axle system and calculate the speed ratio and train value of simple and compound gear train
<b>C308.6</b>	Determine the Mass Moment of Inertia of axisymmetric bodies using Turn Table apparatus, compound pendulum and bifilar suspension

Course Name: 20ME5L2 - CAD / CAM Laboratory	
<b>CO</b>	<b>COURSE OUTCOMES</b>
<b>C309.1</b>	Practice the basic commands in 3D modeling software.
<b>C309.2</b>	Draw 3D part drawings and assemble them using 3D modeling software.
<b>C309.3</b>	Prepare manual part programming and perform machining process in CNC Lathe for the given component.
<b>C309.4</b>	Prepare manual part programming and perform machining process in CNC milling for the given component.
<b>C309.5</b>	Develop a component using 3D printer.
<b>C309.6</b>	Prepare a component using wirecut EDM.

Course Name: 20ME5L3 - Heat and Mass Transfer Laboratory	
<b>CO</b>	<b>COURSE OUTCOMES</b>
<b>C310.1</b>	Determine thermal conductivity of materials by conducting tests on heat conduction apparatus
<b>C310.2</b>	Determine heat transfer rate and fin efficiency of a pin fin under natural/forced convective mode
<b>C310.3</b>	Calculate natural/forced convective heat transfer coefficient by conducting tests on convective heat transfer apparatus.
<b>C310.4</b>	Determine the performance of parallel/counter/cross flow heat exchangers

<b>C310.5</b>	Calculate the Stefan-Boltzmann constant by conducting tests on radiative heat transfer apparatus.
<b>C310.6</b>	Calculate the emissivity of a gray surface.

Course Name: 20ME601 - Design of Transmission Systems	
<b>CO</b>	<b>COURSE OUTCOMES</b>
<b>C311.1</b>	Design a suitable belt drive for a given application.
<b>C311.2</b>	Design chain sprockets for the given power transmission conditions.
<b>C311.3</b>	Design spur and helical gears based on strength and wear consideration.
<b>C311.4</b>	Design bevel gear and worm gear pair based on strength and wear consideration.
<b>C311.5</b>	Design various gear boxes (sliding mesh, constant mesh, multispeed) through geometric progression, standard step ratio, ray diagram and kinematics layout.
<b>C311.6</b>	Design various clutches, internal and external shoe brakes.

Course Name: 20ME602 - Finite Element Analysis	
<b>CO</b>	<b>COURSE OUTCOMES</b>
<b>C312.1</b>	Determine the mathematical modeling constant for the given governing equation by variational and weighted residual methods.
<b>C312.2</b>	Determine the nodal stresses of the structural components using one dimensional analysis.
<b>C312.3</b>	Demonstrate suitable two-dimensional triangular element equation to solve structural problems under plane stress, plane strain and axisymmetric conditions.
<b>C312.4</b>	Determine the steady state nodal temperature for heat flow problems.
<b>C312.5</b>	Determine the stress-strain and strain-displacement relations of the 2-dimensional structural problems by using isoparametric elements
<b>C312.6</b>	Explain the FEA procedure for fatigue analysis and non linear analysis and various approaches in fatigue analysis.

Course Name: 20ME603 - Lean Manufacturing	
CO	COURSE OUTCOMES
C313.1	Explain the fundamental concepts of lean manufacturing
C313.2	Develop a roadmap for successful implementation of lean principles
C313.3	Solve the industrial problems by applying the concepts of lean manufacturing
C313.4	Explain the importance and the role of TPM
C313.5	Demonstrate the concepts of FMEA towards solving productivity related problems
C313.6	Determine the role of Six Sigma in lean manufacturing

Course Name: 20ME604 - Compressible Flow and Turbomachinery	
CO	COURSE OUTCOMES
C314.1	Apply the concepts of compressible flow behaviour in isentropic flow in variable area ducts.
C314.2	Apply the concepts of compressible flow behaviour in constant area ducts with and without heat transfer.
C314.3	Calculate the changes in physical properties when a normal shock occurs in One-dimensional constant area or variable area ducts.
C314.4	Determine the performance of steam turbine.
C314.5	Determine the performance of gas turbine
C314.6	Explain the working and performance of Rotary compressor.

Course Name: 20HS601 - Operations Research	
CO	COURSE OUTCOMES
C315.1	Solve Linear Programming Problems by appropriate technique.
C315.2	Determine the performance characteristics such as time and cost in solving shortest route, transportation problems with an appropriate model.

<b>C315.3</b>	Solve the given assignment problem with an appropriate method.
<b>C315.4</b>	Determine the optimal solution for a project scheduling problem.
<b>C315.5</b>	Determine the order quantity of goods under different constraints.
<b>C315.6</b>	Determine the solutions to single and multi channel queuing problems.

Course Name: 20MC601 - Essence of Indian Traditional Knowledge	
<b>CO</b>	<b>COURSE OUTCOMES</b>
<b>C317.1</b>	Explain philosophy of Indian culture.
<b>C317.2</b>	Distinguish the Indian languages and literature.
<b>C317.3</b>	Explain the philosophy of ancient, medieval and modern India.
<b>C317.4</b>	Acquire the information about the fine arts in India.
<b>C317.5</b>	Know the contribution of scientists of different eras.
<b>C317.6</b>	Explain education systems in India

Course Name: 20ME6L1 - Computer Aided Simulation and Analysis Laboratory	
<b>CO</b>	<b>COURSE OUTCOMES</b>
<b>C318.1</b>	Determine the stresses induced in plates and brackets
<b>C318.2</b>	Determine the deflection of beam with various types of loading problem
<b>C318.3</b>	Calculate the thermal stress and heat transfer in plates.
<b>C318.4</b>	Determine the Stress analysis of axi – symmetric components.
<b>C318.5</b>	Calculate the natural frequency and mode shape analysis of 2D components and beams.

<b>C318.6</b>	Determine the response of harmonic and transient analysis.
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Course Name: 20ME6L2 - Design and Fabrication Project	
<b>CO</b>	<b>COURSE OUTCOMES</b>
<b>C319.1</b>	Identify and apply the real world and societal importance problems in the mechanical and its allied area
<b>C319.2</b>	Identify, analyze, design, implement and handle prototype projects with a complete and organized solution methodologies
<b>C319.3</b>	Apply modern engineering tools for solution
<b>C319.4</b>	Contribute as an individual or in a team in development of technical projects
<b>C319.5</b>	Develop effective communication skills for presentation of project related activities
<b>C319.6</b>	Prepare reports and examination following professional ethics

Course Name: 20ME6A1 - Piping Design Engineering	
<b>CO</b>	<b>COURSE OUTCOMES</b>
<b>C316E1.1</b>	Explain the various piping components and process diagrams
<b>C316E1.2</b>	Apply various codes and standards for piping systems
<b>C316E1.3</b>	Calculate the piping wall thickness and branch reinforcement
<b>C316E1.4</b>	Draw the layout for piping systems and equipment
<b>C316E1.5</b>	Determine the stresses induced in the pipes under various loadings
<b>C316E1.6</b>	Explain the concept of piping layout and stresses acting on it.

Course Name: 20ME6A2 - Product Design and Development	
CO	COURSE OUTCOMES
C316E2.1	Explain the basic concepts of product design and development
C316E2.2	Describe the basic concepts of concurrent Engineering
C316E2.3	Generate various concepts for a product design and to select the best concept
C316E2.4	Discuss the concepts and importance of product architecture
C316E2.5	Illustrate the importance of industrial design in view of aesthetics factors and ergonomic factors
C316E2.6	Apply design for manufacture guidelines for reducing manufacturing cost without compromising quality

Course Name: 20ME6A3 - Digital Manufacturing	
CO	COURSE OUTCOMES
C316E3.1	Describe the basic components of Digital manufacturing
C316E3.2	Implement digital thread components in Manufacturing enterprise
C316E3.3	Perform virtual commissioning of Digital Twin in Smart Factory
C316E3.4	Perform advanced manufacturing process analysis in digital manufacturing enterprise
C316E3.5	Design intelligent manufacturing operations in manufacturing enterprise.
C316E3.6	Formulate business models for advanced manufacturing process

Course Name: 20ME6A4 - Fundamentals of HVAC Systems	
CO	COURSE OUTCOMES
C316E4.1	Estimate heating loads, space heat gains and space cooling loads using accepted engineering methods.



<b>C316E4.2</b>	Explain the phenomena of various heating systems, like gas and oil furnace also understand the concept of Troubleshooting of heating systems
<b>C316E4.3</b>	Explain the Fundamentals of Heat Pumps and its Applications
<b>C316E4.4</b>	Determine the coil loads for cooling and heating systems
<b>C316E4.5</b>	Select equipment and design systems to provide comfort conditions within the building.
<b>C316E4.6</b>	Explain the working principle of chillers used in Commercial Refrigeration Systems

Course Name: 20ME6A5 - Renewable Energy Sources	
CO	COURSE OUTCOMES
<b>C316E5.1</b>	Explain the importance and Economics of renewable Energy
<b>C316E5.2</b>	Explain the method of power generation from Solar Energy
<b>C316E5.3</b>	Explain the method of power generation from Wind Energy
<b>C316E5.4</b>	Explain the method of power generation from Bio Energy
<b>C316E5.5</b>	Explain the power generation method from the newer renewable energy source
<b>C316E5.6</b>	Choose the appropriate power plant by applying the knowledge of characteristics of different power plant and explain its function

Course Name: 20ME6A6 - Applied Hydraulics and Pneumatics	
CO	COURSE OUTCOMES
<b>C316E6.1</b>	Discuss the function of different types of hydraulic pumps and motors.
<b>C316E6.2</b>	Describe the features and functions of hydraulic actuators, Direction and Flow control valves.
<b>C316E6.3</b>	Develop fluid power multi actuation circuits for various purposes in industry.
<b>C316E6.4</b>	Discuss the working of different pneumatic and electro pneumatic components, circuits and systems.

<b>C316E6.5</b>	Construct the cascaded electro pneumatic circuits for requiring cylinder sequences.
<b>C316E6.6</b>	Summarize the various trouble shooting methods and applications of hydraulic and pneumatic systems.

Course Name: 20ME6A7 - Statistical Quality Control	
<b>CO</b>	<b>COURSE OUTCOMES</b>
<b>C316E7.1</b>	Explain the basic Concepts of Quality and its tools.
<b>C316E7.2</b>	Construct the X bar, R & $\sigma$ charts from the available data.
<b>C316E7.3</b>	Construct the p, np, c & u charts from the available data
<b>C316E7.4</b>	Control the occurrence of defects in product or service industries.
<b>C316E7.5</b>	Select and apply appropriate quality control technique for given application.
<b>C316E7.6</b>	Measure the performance of the sampling plans

Course Name: 20OE101 - Mechatronics and Applications	
<b>CO</b>	<b>COURSE OUTCOMES</b>
	Describe the key elements, functions of mechatronics and measurement systems.
	Describe the working principles and characteristics of various types of sensors.
	Discuss about the functions of Signal Conditioning devices and Data Acquisition system.
	Develop the ladder logic diagram for various automatic control operations with PLC.
	Describe the architecture, desirable properties and applications of SCADA system.
	Describe the industrial and domestics applications of various mechatronics system.

Course Name: 20OE102 - Solid free form Manufacturing	
CO	COURSE OUTCOMES
	Recognize the importance in the evolution of SFM, proliferation into the various fields and its effects on supply chain.
	Evaluate the design for AM and its importance in the quality of fabricated parts.
	Describe the principles and applications of polymerization and sheet lamination processes with case studies.
	Explain principles of material extrusion and powder bed fusion processes and design guidelines.
	Perceive jetting and direct energy deposition processes and their applications.
	Recognize the importance in the evolution of SFM, proliferation into the various fields and its effects on supply chain.

Course Name: 20OE103 - Refrigeration and Air Conditioning	
CO	COURSE OUTCOMES
	Explain the principle of refrigeration, cycles, properties and its environment effects.
	Calculate COP of vapor compression Cycle for different processes.
	Explain the different types and working principle of refrigeration Equipment's.
	Describe the working principle of various types of refrigeration systems.
	Discuss psychrometric properties and processes, and air conditioning process
	Estimate cooling load factor, winter and summer air conditioning load and human comfort condition.

Course Name: 20OE104 - Production and Operations Management	
CO	COURSE OUTCOMES
	Explain the different phases in product design and development.
	Forecast demand for Production and Service Systems.

	Formulate and Assess Aggregate Planning strategies and Material Requirement Plan.
	Determine the lot size of a product for the given conditions in an industry.
	Describe the ERP implementation methodology with an example.
	Calculate capacity requirements and developing capacity alternatives.

Course Name: 20ME701 - Mechatronics	
CO	COURSE OUTCOMES
C401.1	Describe the interdisciplinary applications of Electronics, Electrical, Mechanical and Computer Systems for the Control of Mechanical, Electronic Systems and sensor technology.
C401.2	Explain the architecture of Microprocessor and Microcontroller, Pin Diagram, Addressing Modes and Programming of Microprocessor and Microcontroller.
C401.3	Discuss the Programmable Peripheral Interface, Architecture of 8255 PPI, and various device interfacing.
C401.4	Describe the architecture, Programming and applications of Programmable Logic Controllers in industries.
C401.5	Explain the architecture, data flow techniques and graphical programming of Virtual Instruments.
C401.6	Discuss about the various actuators used in mechatronics system using the knowledge and skills acquired through the course.

Course Name: 20HS701 – Management Concepts and Entrepreneurship	
CO	COURSE OUTCOMES
C402E5.1	Compare various management approaches, planning strategies.
C402E5.2	Organize the staffing and structure for an organization
C402E5.3	Make use of communication methods, leadership styles for building effective control in an organization
C402E5.4	Develop entrepreneurial ideas

<b>C402E5.5</b>	Identify the institutions supporting the small-scale industries
<b>C402E5.6</b>	Plan various steps involved in setting up a business enterprise

Course Name: 20ME7L1 - Mechatronics Laboratory	
<b>CO</b>	<b>COURSE OUTCOMES</b>
<b>C406.1</b>	Develop the program for arithmetic functions and the program for sorting, code conversion functions.
<b>C406.2</b>	Develop the program codes to interface with traffic light controller, stepper motor and DC motor.
<b>C406.3</b>	Determine the performance characteristics of LDR, Photo diode and Photo transistors.
<b>C406.4</b>	Construct the hydraulic, pneumatic and electro pneumatic circuits by using simulation software and also interface with PLC.
<b>C406.5</b>	Develop graphical programming language codes for image analysis and temperature data logging system.
<b>C406.6</b>	Construct the circuit to control the temperature, pressure and flow rate of the liquid in process control trainer kit by using DAQ cards with LabVIEW software.

Course Name: 20ME7L2 - Technical Seminar	
<b>CO</b>	<b>COURSE OUTCOMES</b>
<b>C407.1</b>	Function effectively as an individual and Make effective presentation on Engineering/ technology.
<b>C407.2</b>	Review, prepare and present technological developments in the field of mechanical engineering.
<b>C407.3</b>	Design documentation and write effective reports on seminar topics

Course Name: 20ME8L1 - Project Work	
<b>CO</b>	<b>COURSE OUTCOMES</b>
<b>C410.1</b>	Identify and apply the real world and societal importance problems in the mechanical engineering and its allied area

<b>C410.2</b>	Identify, analyze, design, implement and handle prototype projects with a complete and organized solution methodologies
<b>C410.3</b>	Apply modern engineering tools for solution
<b>C410.4</b>	Contribute as an individual or in a team in development of technical projects
<b>C410.5</b>	Develop effective communication skills for presentation of project related activities
<b>C410.6</b>	Prepare reports and examination following professional ethics

Course Name: 20ME7A1 - Data Analytics for Mechanical Engineering	
<b>CO</b>	<b>COURSE OUTCOMES</b>
<b>C404E1.1</b>	Explain the data collection systems using sensors.
<b>C404E1.2</b>	Describe the data processing and handling methods.
<b>C404E1.3</b>	Explain the data security systems.
<b>C404E1.4</b>	Describe the applications of data analytics in manufacturing sector.
<b>C404E1.5</b>	Describe the applications of data analytics in inventory and shipment.
<b>C404E1.6</b>	Describe the applications of data analytics in energy and safety management.

Course Name: 20ME7A2 - Computer Integrated Manufacturing Systems	
<b>CO</b>	<b>COURSE OUTCOMES</b>
<b>C404E2.1</b>	Explain the knowledge about role of computer and automation in manufacturing.
<b>C404E2.2</b>	Explain the concept of group technology and formation of parts – machine cell.
<b>C404E2.3</b>	Explain the concept of FMS, and sizing of FMS systems.
<b>C404E2.4</b>	Describe the automation, types of automation and automation strategies.

<b>C404E2.5</b>	Describe Automated Guided Vehicle System and its application.
<b>C404E2.6</b>	Describe the application of computer in CAPP, and explore to integrated planning software.

Course Name: 20ME7A3 - Additive Manufacturing	
<b>CO</b>	<b>COURSE OUTCOMES</b>
<b>C404E3.1</b>	Explain the process of Rapid prototyping, Rapid tooling and Rapid manufacturing and describe the benefits and applications of AM process.
<b>C404E3.2</b>	Explain data processing for Additive Manufacturing Technology.
<b>C404E3.3</b>	Differentiate MIMICS and MAGICS software's used in AM process.
<b>C404E3.4</b>	Explain the principle, Processes, applications of SLA, SGC, FDM and LOM processes.
<b>C404E3.5</b>	Explain the principle, Processes, applications of SLS and LENS.
<b>C404E3.6</b>	Explain the principle, Processes, applications of 3D printing and SDM processes

Course Name: 20ME7A4 - Automobile Engineering	
<b>CO</b>	<b>COURSE OUTCOMES</b>
<b>C404E4.1</b>	Explain the various types of engines and components.
<b>C404E4.2</b>	Explain the various types of injection and ignition systems.
<b>C404E4.3</b>	Describe the various types of chassis, frame and steering systems.
<b>C404E4.4</b>	Distinguish between the manual transmissions systems with automatic transmission systems.
<b>C404E4.5</b>	Describe the operation of the brakes and the suspension systems.
<b>C404E4.6</b>	Describe the importance of alternate fuels for IC engines.

Course Name: 20ME7A5 - Computational Fluid Dynamics	
CO	COURSE OUTCOMES
C404E5.1	Apply the fundamentals of CFD to derive governing equations
C404E5.2	Discretize 1 D steady and transient diffusion equations using finite difference method.
C404E5.3	Discretize 1 D steady and transient diffusion equations using finite volume method
C404E5.4	Derive finite volume equations for 1 D convention diffusion problem.
C404E5.5	Explain SIMPLE algorithm.
C404E5.6	Describe various turbulence models.

Course Name: 20ME7A6 - Supply Chain and Logistic Management	
CO	COURSE OUTCOMES
C404E6.1	Describe the role and drivers of and supply chain management in achieving competitiveness.
C404E6.2	Explain about Supply Chain Network Design.
C404E6.3	Illustrate about the issues related to Logistics in Supply Chain.
C404E6.4	Appraise about Sourcing and Coordination in Supply Chain.
C404E6.5	Explain about the application of Information Technology and Emerging Concepts in Supply Chain.
C404E6.6	Describe about warehouse management.



Course Name: 20ME7A7 - Maintenance Engineering	
CO	COURSE OUTCOMES
C404E7.1	Explain the principles, functions of maintenance activities.
C404E7.2	Describe the different maintenance categories.
C404E7.3	Describe the principles and methods of lubrication.
C404E7.4	Explain about condition monitoring and instruments used in industry.
C404E7.5	Describe the repair methods used for basic machine elements like bed, slide ways.
C404E7.6	Describe the repair methods used for material handling equipment.

Course Name: 20ME7B1 - Product Life Cycle Management	
CO	COURSE OUTCOMES
C405E1.1	Explain the history, concepts and terminology of PLM
C405E1.2	Describe the functions of PLM/PDM
C405E1.3	Explain the features of PLM/ PDM
C405E1.4	Classify the different modules offered in commercial PLM/PDM tools.
C405E1.5	Predict PLM/PDM approach techniques for industrial applications.
C405E1.6	Explain PLM/PDM with legacy data bases, CAx& ERP systems

Course Name: 20ME7B2 - Design of Jigs, Fixtures and Press Tools	
CO	COURSE OUTCOMES
C405E2.1	Summarize the different methods of Locating Jigs and Fixtures and Clamping principles
C405E2.2	Design and develop jigs and fixtures for given component
C405E2.3	Discuss the press working terminologies and elements of cutting dies
C405E2.4	Distinguish between Bending and Drawing dies.
C405E2.5	Discuss the different types of forming techniques
C405E2.6	Summarize the different methods of Locating Jigs and Fixtures and Clamping principles

Course Name: 20ME7B3 - Process Planning and Cost Estimation	
CO	COURSE OUTCOMES
C405E3.1	Explain about method study procedure & its techniques and work measurement.
C405E3.2	Select material, process, production equipment, tooling and process parameters for the given product.
C405E3.3	Prepare a process planning sheet from a design drawing considering various production and design parameters.
C405E3.4	Apply the step by step procedure for estimating the cost of any product.
C405E3.5	Express the different elements of cost of a product and compute the total cost of a given product.
C405E3.6	Calculate machining time for different lathe operations, drilling, boring, milling, shaping, planing and grinding

Course Name: 20ME7B4 - Power Plant Engineering	
CO	COURSE OUTCOMES
C405E4.1	Calculate the efficiency of Rankine cycle.
C405E4.2	Explain the functioning of combined power plants.
C405E4.3	Calculate the efficiency of Various types of gas power cycles
C405E4.4	Explain the working of various types of nuclear power plant
C405E4.5	Explain the working principle of various renewable energy power plants.
C405E4.6	Explain the different tariff procedures for energy consumption

Course Name: 20ME7B5 - Energy Conservation and Management	
CO	COURSE OUTCOMES
C405E5.1	Summarize the energy conservation scenario, energy and environment, air pollution, climate change, and various acts and policy for the energy conservation
C405E5.2	Infer the concept of financial management, energy monitoring and targeting
C405E5.3	Explain energy audit for the energy management and operation of energy audit instruments.
C405E5.4	Determine energy efficiency in various thermal utilities and systems
C405E5.5	Explain working of waste heat recovery systems
C405E5.6	Summarize the Convention on Climate Change and Clean Development Mechanism

Course Name: 20ME7B6 - Industrial Robotics	
CO	COURSE OUTCOMES
C405E6.1	Explain about the robot parts, specifications, coordinates and robot drive system.
C405E6.2	Discuss the working principle of robot sensors and types of end effectors.
C405E6.3	Explain the Image processing techniques to analyze the real images.
C405E6.4	Explain the forward and reverse kinematics of manipulators with two, three and four degrees of freedom.
C405E6.5	Discuss the commands to control the motion of sensor and end effectors in robot programming languages.
C405E6.6	Describe the steps for implementation of robots in industries and safety considerations for robot operations.

Course Name: 20ME7B7 - Engineering Economics and Cost Analysis	
CO	COURSE OUTCOMES
C405E7.1	Determine the break-even point for a given production system.
C405E7.2	Compute time value equivalent for various cash flow.
C405E7.3	Describe various methods of comparison of alternatives.
C405E7.4	Choose a suitable replacement policy for items deteriorating with time.
C405E7.5	Choose a suitable replacement policy for machines with infinite horizon.
C405E7.6	Explain various determinants of cost.

Course Name: 20ME8A1 - Innovation in Design	
CO	COURSE OUTCOMES
C408E1.1	Explain seven concerns in design thinking.

<b>C408E1.2</b>	Describe new needs to context with example.
<b>C408E1.3</b>	Describe the constraints and technologies for comprehension.
<b>C408E1.4</b>	Identify the crucial steps missed in check
<b>C408E1.5</b>	Identify the manufacturing challenges in crafting.
<b>C408E1.6</b>	Explain the innovation domains.

Course Name: 20ME8A2 - Unconventional Machining Processes	
<b>CO</b>	<b>COURSE OUTCOMES</b>
<b>C408E2.1</b>	Explain the need for unconventional machining processes and its classification.
<b>C408E2.2</b>	Explain various mechanical energy based unconventional machining processes.
<b>C408E2.3</b>	Compare various thermal energy and electrical energy based unconventional machining processes.
<b>C408E2.4</b>	Summarize various chemical and electro-chemical energy based unconventional machining processes.
<b>C408E2.5</b>	Explain various nano abrasives based unconventional machining processes.
<b>C408E2.6</b>	Distinguish various recent trends based unconventional machining processes.

Course Name: 20ME8A3 - Production Planning and Control	
<b>CO</b>	<b>COURSE OUTCOMES</b>
<b>C408E3.1</b>	Explain various aspects of product development.
<b>C408E3.2</b>	Describe work sampling techniques.
<b>C408E3.3</b>	Determine the quantity in batch production system.

<b>C408E3.4</b>	Explain scheduling rules
<b>C408E3.5</b>	Determine manufacturing lead time for the given production system.
<b>C408E3.6</b>	Explain MRP and ERP.

Course Name: 20ME8A4 - Battery Technology	
<b>CO</b>	<b>COURSE OUTCOMES</b>
<b>C408E4.1</b>	Describe the construction and working of lead acid batteries.
<b>C408E4.2</b>	Explain the construction and working of lithium ion batteries.
<b>C408E4.3</b>	Discuss about the testing of batteries.
<b>C408E4.4</b>	Explain the battery pack system.
<b>C408E4.5</b>	Discuss about the battery management system.
<b>C408E4.6</b>	Discuss the environmental aspects, energy consumption, reuse and recycling of batteries.

Course Name: 20ME8A5 - Testing of Materials	
<b>CO</b>	<b>COURSE OUTCOMES</b>
<b>C408E5.1</b>	Explain the purpose of testing and its classification.
<b>C408E5.2</b>	Explain different types of testing standards and advantages of testing.
<b>C408E5.3</b>	Explain the working principles of mechanical testing methods
<b>C408E5.4</b>	Describe the concepts of non-destructive testing and their applications
<b>C408E5.5</b>	Explain the working of material characterization testing methods and their applications.
<b>C408E5.6</b>	Explain the concepts of thermal and chemical testing methods.

Course Name: 20HS6A1 - Intellectual Property Rights	
CO	COURSE OUTCOMES
C408E6.1	Explain the fundamental aspects of Intellectual property Rights which plays a major role in development and management of innovative projects in industries.
C408E6.2	D Describe the patents, patent regime in India and abroad and registration aspects.
C408E6.3	Describe the copyrights and its related rights and registration aspects.
C408E6.4	Explain the trademarks and registration aspects.
C408E6.5	Explain the Design, Geographical Indication (GI), Plant Variety and Layout Design Protection and their registration aspects.
C408E6.6	Analyze the current trends in IPR and Government steps in fostering IPR

Course Name: 20ME8B1 - Two Wheeler and Four Wheeler Overhauling	
CO	COURSE OUTCOMES
C409E1.1	Explain two stroke and four stroke SI and CI engines and valve & port timing diagrams.
C409E1.2	Explain the different circuits in two wheeler fuel systems and ignition system.
C409E1.3	Describe the main frame for two and four wheelers, chassis and drive systems for two wheelers.
C409E1.4	Describe the different types of clutches, gear box and suspension systems.
C409E1.5	Describe the different types of brake system for two wheeler and four wheeler, wheels and tyres.
C409E1.6	Explain the different types of cooling systems and lubrication systems.

Course Name: 20ME8B2 - Industrial Safety Engineering	
CO	COURSE OUTCOMES
C409E2.1	Illustrate the importance of safety of employees while working with machineries.
C409E2.2	Illustrate the importance of safety of employees while working with welding and gas cutting processes
C409E2.3	Understand the importance of safety principles in hot and cold working of metals
C409E2.4	Explain the concept of inspection and testing in boilers
C409E2.5	Explain the radiation hazards
C409E2.6	Describe the hazards caused by industrial noise.

Course Name: 20ME8B3 - Welding Technology	
CO	COURSE OUTCOMES
C409E3.1	Explain the basics of welding.
C409E3.2	Compare different types of gas and arc welding processes.
C409E3.3	Explain the working principle of resistance welding processes and various process parameters influence on their performance.
C409E3.4	Describe the working of various types of solid state welding processes.
C409E3.5	Explain the working principle of special welding processes and their applications.
C409E3.6	Explain the various welding defects, weldability and testing methods.



Course Name: 20ME8B4 - Composite Materials and Mechanics	
CO	COURSE OUTCOMES
C409E4.1	Explain the different types of the composite materials and its applications.
C409E4.2	Explain the various processing techniques for polymer composites manufacturing.
C409E4.3	Explain the different types of processing techniques for metal matrix composites manufacturing.
C409E4.4	Determine the stress strain and strain displacement relationship matrix for polymer composites.
C409E4.5	Determine the buckling, and bending behaviours of polymer composites.
C409E4.6	Determine the natural frequency of polymer composites.

Course Name: 20ME8B5 - Advanced Internal Combustion Engines	
CO	COURSE OUTCOMES
C409E5.1	Explain fuel injection systems in SI engine, types of combustion chamber and combustion process.
C409E5.2	Explain different types of fuel injection system and combustion chambers of CI engine.
C409E5.3	Explain different types of air motion, and Turbo charging of IC Engine.
C409E5.4	Explain the mechanism of pollution formation and the evolution of emission norms.
C409E5.5	Describe the properties of various alternative fuels, engine modification required and emission characteristic of alternative fuels.
C409E5.6	Discuss various ignition methods used in I.C engine and electronic engine management system

Course Name: 20HS7A2 - Total Quality Management	
CO	COURSE OUTCOMES
C409E6.1	Explain basic concepts, TQM framework, Barriers and Benefits of TQM.
C409E6.2	Explain the TQM Principles for application.
C409E6.3	Define the basics of Six Sigma and Traditional tools, New tools, Benchmarking and FMEA.
C409E6.4	Describe Taguchi's Quality Loss Function, Performance Measures and apply Techniques like QFD, TPM, COQ and BPR.
C409E6.5	Illustrate and apply QMS and EMS in any organization.
C409E6.6	Explain the process of implementation of ISO 9000/9001-2008/14000 for given manufacturing, service sector.

Course Name: 20OE105 - Solar Photovoltaic Fundamentals and Applications	
CO	COURSE OUTCOMES
	Summarize the basics of Photovoltaic systems.
	Explain the component of stand- alone photovoltaic systems
	Explain the component of grid connected photovoltaic systems
	Summarize the basics of Hybrid systems.
	Explain the selection criteria for a given Photovoltaic application.
	Design of various components of solar PV systems.

Course Name: 20OE106 - Fundamentals of Product Design	
CO	COURSE OUTCOMES
	Explain the basic concepts of product design
	Describe the basic concepts of concurrent Engineering
	Generate various concepts for a product design and to select the best concept
	Discuss the concepts and importance of product architecture
	Apply the quality concepts to develop robust product
	Illustrate the importance of industrial design in view of aesthetics factors and ergonomic factors

Course Name: 20OE107 - Autonomous and Electric Vehicle	
CO	COURSE OUTCOMES
	Discuss the latest technologies in the design of autonomous systems.
	Explain the perception of autonomous system.
	Explain the prediction and routing of autonomous system.
	Explain the planning and control of autonomous driving.
	Explain the importance of electric vehicle and energy storage system.
	Discuss about the hybrid electric vehicles.

Course Name: 20OE108 - Industrial Safety Practices

<b>CO</b>	<b>COURSE OUTCOMES</b>
	Illustrate the importance of safety in Boilers and Pressure vessels.
	Identify and prevent chemical, environmental mechanical, fire hazard.
	Collect, analyze and interpret the accidents data based on various safety techniques.
	Apply proper safety techniques on safety engineering and management.
	Perform hazard analysis.
	Design the system with environmental consciousness by implementing safety regulation.